A Redescription of Cathemasia mehrai Wesley, 1940 (Trematoda) From Dissoura episcopa episcopa (White Necked Stork) With A Review of the Species of Cathemasia Looss, 1899 (Trematoda) Occurring in Indian Storks

Dissertation Submitted to the Department of Zoology in Partial Fulfilment of the Requirements for the award of the Degree of

MASTER OF SCIENCE

IN

ZOOLOGY

By

AMITABH KUMAR

DEPARTMENT OF ZOOLOGY
Aligarh Muslim University,
Aligarh.

1976

A REDESCRIPTION OF *Cathemasia mehrai* WESLEY, 1940 (TREMATODA) FROM *Dissoura episcopa episcopa* (WHITE NECKED STORK) WITH A REVIEW OF THE SPECIES OF *Cathemasia* LOOSS, 1899 (TREMATODA) OCCURRING IN INDIAN STORKS

COURSE NO. 5ZY-72

PROJECT IN PARASITOLOGY

DISSERTATION SUBMITTED TO THE DEPARTMENT OF ZOOLOGY

IN

PARTIAL FULFILMENT OF THE REQUIREMENTS

FOR

THE AWARD OF THE DEGREE OF

MASTER OF SCIENCE (ZOOLOGY)

1974-76

Amitabh Kumar

M.Sc. Parasitology

DEPARTMENT OF ZOOLOGY

THE ALIGARH MUSLIM UNIVERSITY,

ALIGARH.

1976

A C K N O W L E D G E M E N T

I have a great pleasure in expressing my deep sense of gratitude to Dr. A.H.Siddiqi, for providing me the specimens and his valuable guidance. I am also indebted to him for his going through the manuscript and making necessary corrections.

I render my thanks to my friends for their help in this work.

A. Kumar

C O N T E N T S

INTRODUCTION

The genus Cathemasia was erected by Looss (1899) with Cathemasia hians as its type species. C. hians was previously described as Distomum hians by Rudolphi (1809). The specimens were collected from the esophagus of the black stork, Ardea nigra (= Ciconia nigra). Looss (1899) described the genus Cathemasia with Omphalometra under the sub-family Omphalometrinae erected by the same author. Poche (1926) described the genus Cathemasia under the family Fasciolidae.

Cathemasia and a new genus Mehlisia Johnston, 1913 based on M. acuminata Johnston, 1913 was included in the family Cathemasidae erected by Fuhrmann (1928), Cathemasia being the type genus of the family Cathemasidae. However, Fuhrmann held the opinion that the family Cathemasidae having the above two genera resembles closely the family Echinostomatidae. This view was supported by Wesley (1940), who did not consider the absence of the collar in the family Cathemasidae as a regular and constant feature, though a distinct but vestigial collar armed with collar spines is present in Cathemasia mehrai Wesley, 1940. In his opinion the only difference between Cathemasidae and Echinostomatidae is the absence of the lateral branches in the short median stem of the 'Y' shaped excretory bladder in the former. He did not consider it adequate for the creation of a new family Cathemasidae a nd he therefore reduced Cathemasidae from a family status to a sub-family rank

Cathemasinae under the family Echinostomatidae.

Mendheim (1940) discussed the phylogeny of the Echinostomatidae and the related groups and traced the "Cathemasidae" from the Echinostomatidae via the genus Artyfechinostomum. His hypothesis was based on increasing reduction of the head collar. As stated above the relation of Cathemasia to Echinostomatidae can not be denied on other grounds also. But, to place the relationship between Cathemasidae and Echinostomatidae more investigations into morphology, life-cycles and distribution of the various species are needed.

L. Szidat (1940)a) collected a valuable evidence in this connection by discovering the cercaria of Cathemasia hians. This cercaria, C. choanophila U. Szidat, 1936, has a head collar with 47 small and weak spines, like that of the echinostome cercáriae. At first it was regardéd as a normal echinostome cercaria until L. Szidat showed that it belongs to Cathemasia hians. Its excretory system is also similar fundamentally to that of echinostome cercariae.

Travassos (1951) in a detailed revised study extended the family Cathemasidae. He suppressed the sub-family Omphalometrinae and replaced it with Cathemasinae. He included several genera in the family Cathemasidae on account of common morphological characters.

Van Den Broek (1960) has described a rudimentary head collar with weak spines in mature adults of Cathemasia variabilis Van Den Broek, 1960, confirming the close relationship between Cathemasia and Echinostomatidae. However, in her opinion it would be unauthentic to regard the family Cathemasidae as a sub-family of Echinostomatidae before sufficient investigations have been undertaken.

During the year 1963 and 1968 flukes belonging to the genus Cathemasia were collected from white necked storks, Dissoura episcopa episcopa. First, in 1963 a large number of juveniles were found to occur below the lining of the gizzard. Scince they were in such a stage of development and immaturity, they could not be identified with certainty. Although scale like spines, so Characteristic of Cathemasia, were present, they could not be placed in the genus because a head collar of spines was also present. It was later on in 1968 that a number of adult trematodes from the esophagus and some juveniles from the gizzard were collected from the white necked storks that the 1963 material could be identified as belonging to Cathemasia. Detailed study revealed that these parasites belong to Cathemasia mehrai Wesley, 1940. When compared with the original description of the species many variations were noticed, therefore a redescription of the adults as well as of the juveniles of C. mehrai is given below.

A REDESCRIPTION OF CATHEMASIA MEHRAI

A. ADULTS

Host : Dissoura episcopa episcopa

Location : Esophagus

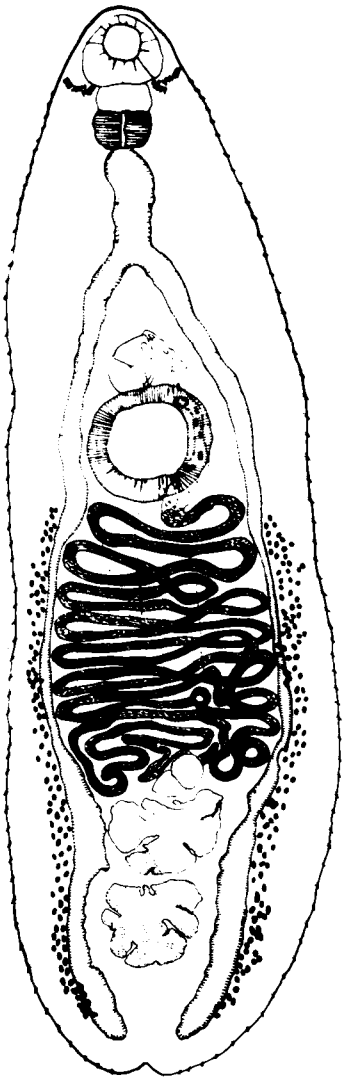
Locality : Aligarh

The specimens are elongate, oval, slightly tapering anteriorly and rounded posteriorly (Fig. 1). They measure 5.45mm-12.58mm in maximum length and 1.91mm-3.77mm in maximum width. A rudimentary head collar is present and is armed with three groups of spines- (i) Corner spines 4-5 in number. (ii) Lateral spines 8-10 in number and (iii) Dorsal spines 19 in number. The spines are usually lost in adults but distinctly seen in preadults. Cuticle is thick and its entire ventral and dorsal surface is covered with backwardly pointing scales, these body scales are of variable size and shape. The various types of scales present on ventral and dorsal surface are shown in Fig. 6d & 6e respectively. The scales of the ventral surface are more prominent.

The mouth is sub-terminal, surrounded by an oral sucker, measuring 0.464mm-0.754mm in maximum length and 0.58mm-0.986mm in maximum width. The ventral sucker is present in the anterior portion of the middle third of the body, and measures 0.638mm-1.392mm in maximum length and 0.661mm-1.45mm in maximum width. The ratio of the diameters of the suckers is 1:1.5.

A short prepharynx is present, and it leads into a muscular and ovoid pharynx which measures 0.35mm-0.81mm in maximum length and 0.29mm-0.69mm in

Fig. 1. Ventral view of *Gathemasia mehrai* (Adult)



maximum width. The esophagus is short and measures 0.406mm-1.16mm in length. The esophagus leads into two intestinal ceca which terminate a little short of posterior extremity. The ceca are provided with small outpocketings.

The testes are tandem, deeply lobed, postovarian, intercecal and are located in the posterior third of the body. The anterior testis measures 0.255mm-0.87mm x 0.58mm-1.62mm. The size of the posterior testis is 0.638mm-1.392mm x 0.464mm-1.566mm. The oval cirrus sac is situated about 0.408mm-0.788mm behind the intestinal bifurcation. It measures 0.43mm-0.76mm in maximum length and 0.56mm-1.57mm in maximum width. Seminal vesicle is bipartite, internal, coiled in young specimens and sac shaped in adults. Pars prostatica and ejaculatory duct are present. Cirrus is long and coiled. The genital opening is situated almost at the anterior tip of cirrus sac. The ovary is immediately pretesticular, oval or transversely elongated measuring 0.149mm-0.4mm in maximum length and 0.163mm-0.312mm in maximum width. The uterus is intercecal with uterine coils occupying almost all the space between ventral sucker and ovary. Metraterm is well developed, muscular, from posterior level of ventral sucker to genital pore. The vitellaria are extracecal and extend from posterior level of ventral sucker to posterior end of ceca, but in some specimens the follicles extend up to anterior level of ventral sucker.

The eggs measure 0.066mm-0.087mm x 0.026mm-0.038mm.

Eggs contain miracidia with eye spots pigments in the distal portion of the uterus.
The excretory vesicle is Y- shaped.

B. JUVENILES

Host : Dissoura episcopa episcopa
Location : Below the gizzard lining
Locality : Aligarh

The specimens are elongate, oval, rounded at both extremities (Fig. 2) measuring 2.14mm-5.45mm in maximum length and 0.81mm-1.9mm in maximum width.
A rudimentary head collar is present and is armed with three groups of spines- (i) Corner spines 4-5 in number (Figs.3,4 & 6b), (ii) Lateral spines 8-10 in number (Figs. 3,4 & 6c) and (iii) Dorsal spines 19 in number (Figs. 5 & 6a). The spines are more distinct in the juveniles than in the adults. Cuticle is thick and itsentire ventral and dorsal surface is covered with backwardly pointing scales, these body scales are of variable size and shapesas shown in Figs. 3,4 & 6d and Figs. 5 & 6e respectively. The scales are more distinct in the juveniles than in the adults.

The mouth is subterminal, surrounded by an oral sucker, measuring 0.285mm-0.36mm in maximum length

Fig. 2. Whole mount of Cathemasia mehrai (Juvenile)

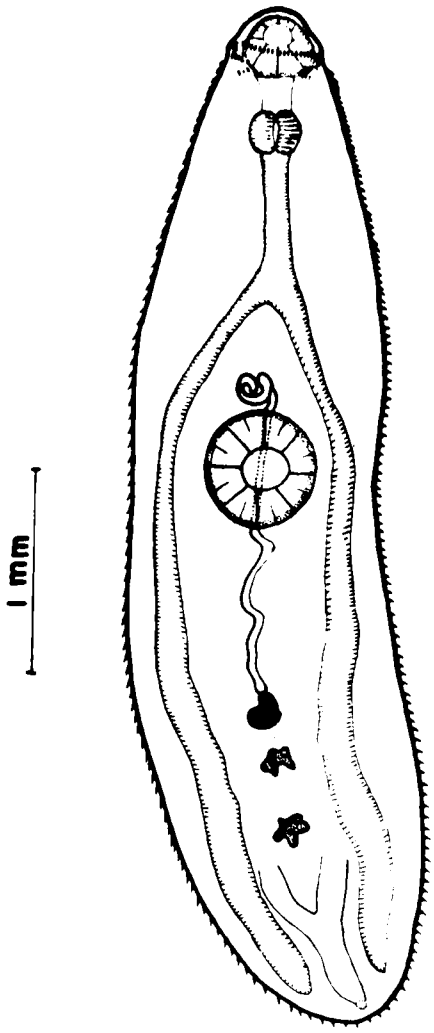


Fig. 2

Fig. 3. Ventral view of anterior end of *Cathemasia mehrai* (Juvenile)

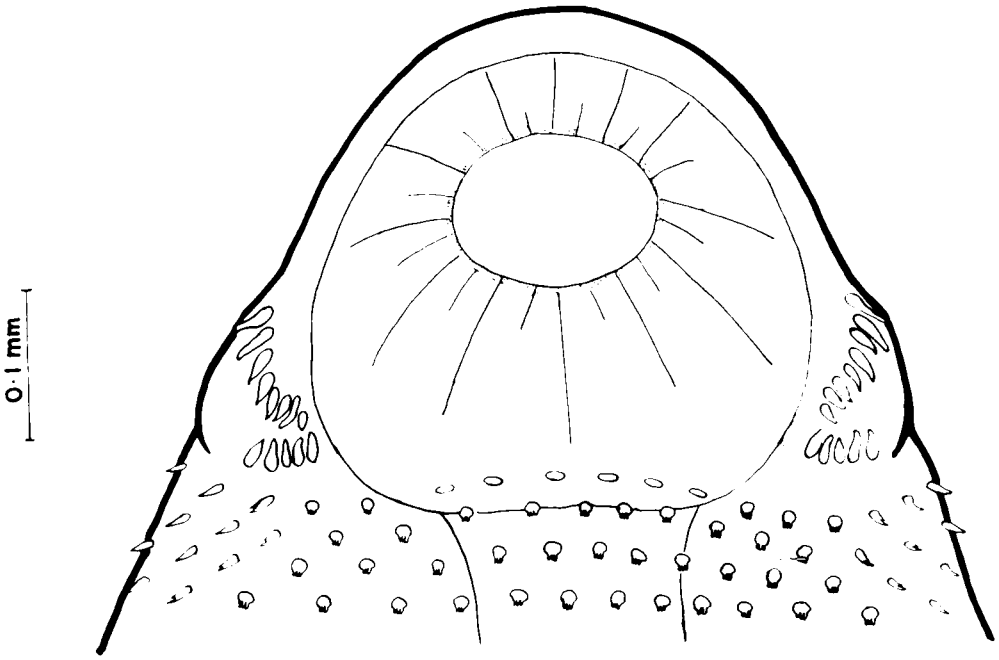


Fig. 3

Fig. 4. Ventral view of anterior end of Cathemasia mehrai (Juvenile) showing dorsal spines.

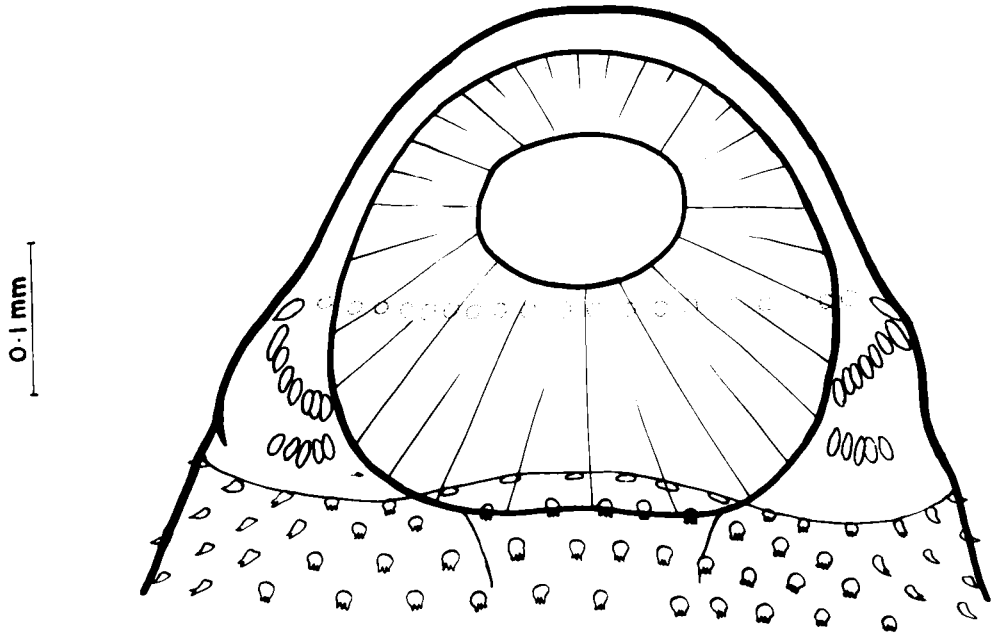


Fig. 4

Fig. 5. Dorsal view of anterior end of Cathemasia mehrai (Juvenile)

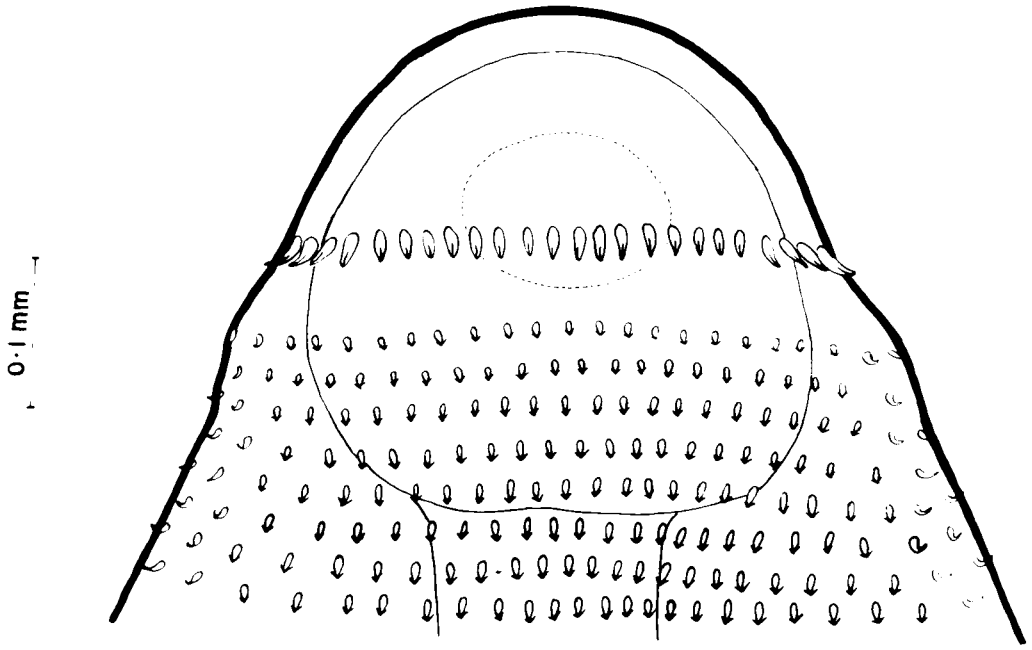


Fig. 5

Fig. 6a. Various types of Dorsal spines.

Fig. 6b. Various types of Cornef spines.

Fig. 6c. Various types of Lateral spines.

Fig. 6d. Various types of body scales on ventral side.

Fig. 6e. Various types of body scales on dorsal side.

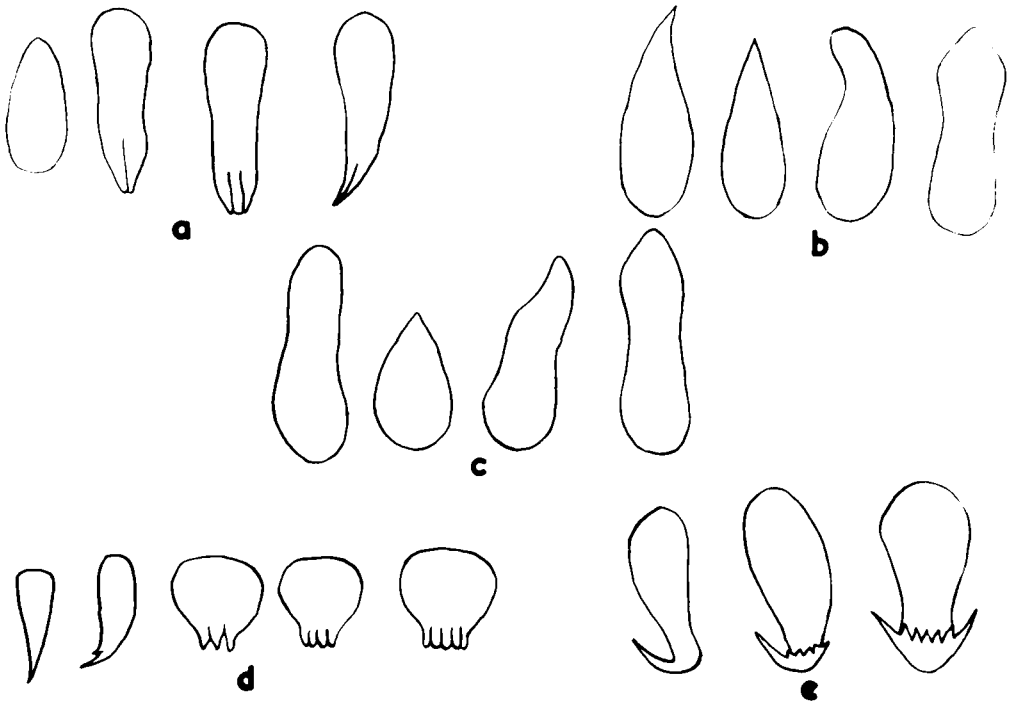


Fig. 6

and 0.34mm-0.421mm in maximum width. The ventral sucker is present in the anterior middle third of body measuring 0.382mm-0.571mm in maximum length and 0.34mm-0.66mm in maximum width. The ratio of the diameters of the two suckers is 1:1.5.

A short prepharynx is present measuring 0.068mm-0.204mm in maximum length and 0.054mm-0.408mm in maximum width. The pharynx is muscular and measures 0.174 mm-0.243mm in maximum length and 0.104mm-0.185mm in maximum width. The pharynx leads into an esophagus measuring 0.15mm -0.29mm in length. The intestinal ceca terminate a little short of the posterior extremity, with or without outpockетings.

Rudiments of the reproductive organs are seen. Testes tandem, slightly lobed, in advance stages deeply lobed and present in the posterior third of body. The anterior testis measures 0.136mm-0.299mm x 0.244mm-0.625mm in maximum length and width. The oval cirrus sac is thin walled and situated 0.299mm-0.435mm behind the intestinal bifurcation. It measures 0.163mm-0.258mm in maximum length and 0.163mm-0.244mm in maximum width. Seminal vesicle is bipartite, internal, coiled in young specimens as compared to sac shaped in adults. Pars prostatica and ejaculatory duct present, cirrus long and coiled. Genital opening situated anteriorly.

Ovary immature measuring 0.095mm-0.163mm in maximum length and 0.95mm-0.19mm in maximum width. Uterus intercecal, in the form of a single spiral tube. Uterine coils absent. Vitellaria not yet developed.

The excretory vesicle is Y- shaped.

R E M A R K S :

Cathemasia mehrai Wesley, 1940 was described from Pseudibis papillosus. The present material was collected from Dissoura episcopa episcopa which is a new host record. Compared with the original description, the present material differs in having larger body size, sucker ratio, and number of spines in the head collar. Wesley (1940) described only corner spines and lateral spines which were 12 in number. In the present material, there a total of 45-49 spines. It is obvious that the dorsal spines are lost in adults and Wesley was unable to pbserve them. Our description is based on both

juveniles and young adults which still possess a complete set of all three kinds of spines.

D I S C U S S I O N

Pande et al. (1960) have also described Cathemasiid juveniles from Xenorhynchus asiaticus and Ibis leucocephalus from the proventriculus and esophagus of the hosts. Some specimens were extracted from the glands of the proventriculus. A few specimens were also recovered from the esophagus of the hosts.

In the present investigations also the juveniles were recovered from below the lining of the gizzard of the host bird. As such it was exceedingly difficult to ascribe these juveniles with any degree of certainty to any particular species of trematode. However, it seemed reasonable to assume from the development of the head collar and the arrangement of the head collar spines that the juveniles show many features of the Artyfechinostomum sufrartyfex + Euparyphium malayanum complex. They also bear a certain resemblance to Protechinostomum Beaver, 1943 from which they differ in the size of the head collar spines, which are equal to body spines in Protechinostomum. It was only after the recovery of adults along with the juveniles and preadults described above from the same host species, Dissoura episcopa episcopa that the true relationship was established and the juveniles were assigned to Cathemasia.

Two facts clearly emerge from the foregoing discussion. Firstly, in the life-cycle of Cathemasiids there is certainly a developmental part of the

larval stages which undergo through a tissue phase in the gizzard or proventriculus glands. It is only after completing this phase that the juveniles emerge from their tissue phase and ascend to the esophagus, the normal site of infection of adults. Several young worms in various stages of development were collected between the gizzard and the esophagus along with adults which localized themselves in the esophagus alone. This can be an important factor in tracing the phylogenetic relationship of Cathemasiids with Echinostomatids. Secondly, there is a great deal of similarity between the larval stages of Cathemasiids and Echinostomatids. This fact is further supported by evidence already available in literature and clearly indicate the close relationship of the two groups.

U. Szidat (1936) described Cercaria choanophila which possesses 47 small and weak spines and it was conclusively demonstrated by L. Szidat (1940) to that it belongs to Cathemasia hians. Van Den Broek (1960) has described a rudimentary head collar with weak spines in the adults of Cathemasia variabilis.

The presence of spines in adults of Cathemasia mehrai and its juveniles supports the idea that all Cathemasia species should possess spines in their early developmental stages. As the worms grow

larger, these spines are probably lost. They may also be lost as a result of processing and staining techniques as well.

From the evidence presented above and the facts reported by earlier workers, it is not difficult to conclude that Cathemasia is very closely related to Echinostomatidae and Wesley (1940) appears to be right in placing Cathemasiinae under Echinostomatidae. A separate family rank for Cathemasidae is unwarranted. In future, workers in this group should carefully look for the presence of spines both in living adults and juveniles which may be usually found to occur in the proventriculus glands or below the lining of the gizzard.

A REVIEW OF THE SPECIES OF CATHEMASIA LOOSS, 1899 (TREMATODA) OCCURRING IN INDIAN STORKS

According to Broek (1963), who has given a detailed revision there are only six species in the genus, which occur in Indian birds. Wesley (1940) described Cathemasia orientalis, C. indicus, C. mehrai and C. seetali (1943). The infection of C. hians Rudolphi, 1809, is commonly found in Kashmir (Fotedar, personal communication). Travassos (1951) described the sixth species, C. dollfusi from an Indian stork. Out of these six species Broek (1963) has indicated her doubts about the validity of C. dollfusi which has been recorded from Xenorhynchus asiaticus, a stork which also harbours C. seetali Wesley, 1943. According to Broek (1963) there is no difference between C. dollfusi and C. seetali and the former should be considered a synonym of the latter. This was also supported by Stunkard & Gandal (1965).

Table I summarizes host - parasite records of the Indian species of Cathemasia. A glance at this table immediately reveals that these trematodes are not very host specific and can occur interchangeably in different species of Indian storks. Cathemasia mehrai appears to be the least of all host specific. It has been recorded from three different species of storks.

Mehrastomum minutum Saksena, 1959 from Dissoura episcopa episcopa appears to be an immature form

of a Cathemasia sp. A head collar has been reported by Saksena (1959) but without spines. A reexamination of the specimens may reveal the presence of collar spines. In most cases i.e. in body size, size of the various organs and in sucker ratio M. minutum resembles with the juveniles of C. mehrai Wesley, 1940. Since Dissoura episcopa episcopa is also the host of C. mehrai, there is strong possibility that Mehrastomum minutum is nothing but a synonym of Cathemasia mehrai.

Farooqui (1960) described Cathemasioides caballeroi from Xenorhynchus asiaticus. A reexamination of the type specimen revealed that the egg size is 0.056mm-0.059mm x 0.026mm-0.032mm and not 0.09mm x 0.025mm and a rudimentary head collar with weak spines is present. Also the specimens are not fixed and pressed properly there by giving it a wrinkled appearance. In all probability it is similar to Cathemasia mehrai. Cathemasioides caballeroi should therefore be reduced to synonymy with Cathemasia mehrai Wesley, 1940.

Recently three more new species under a new genus Digitorchis related to Cathemasia are described by Gupta (1960) from three species of Indian storks. It appears that Gupta did not compare his material viz., Digitorchis odhneri, D.stunkardi and D. yamaguti with

the four species described by Wesley (1940, 1943) from storks. A detailed comparison (see Tables II, III & IV) with those of Wesley's species reveals the following facts :

Digitorchis odhneri is the same as Cathemasia indicus and both are from the same host species Ibis leucophalus (painted stork). D. odhneri should therefore be considered a synonym of C. indicus.

Digitorchis stunkardi is the same as Cathemasia seetali. The former is however reported from Dissoura episcopus and the latter from Xenorhynchus asiaticus. D. stunkardi is considered here a synonym of C. seetali and X. asiaticus is a new host record for C. seetali.

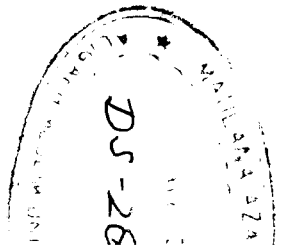
Digitorchis yamaguti is very similar to Cathemasia mehrai except for the absence of head collar spines and has been recorded from Xenorhynchus asiaticus. The type specimens of this species should be reexamined for the presence of spines, in which case it will become a synonym of C. mehrai .It has already been pointed out above that C. mehrai has also been recorded from X. asiaticus.

The generic diagnosis of Digitorchis provided by Gupta (1968) does not encompass even his own other species described in the same publication. Digitorchis is therefore a synonym of Cathemasia and its erection was quite unjustified.

There are therefore only five species of Cathemasia which occur in Indian storks, viz. C. indicus, C. orientalis, C. mehrai, C. seetali and C. hians.

Host-parasite list of Indian species of Cathemasia.

Species	Author	Year	Host	Remarks
C. orientalis	Wesley,	1940	Dissoura e. episcopa	
C. indicus	Wesley,	1940	Ibis leucocephalus	
C. indicus	Gupta,	1968	Ibis leucocephalus	Described as Digitorchis odhneri
C. mehrai	Wesley,	1940	Pseudibis papilosus	
C. mehrai	Farooqui,	1960	Xenorhynchus asiaticus	Described as Cathemasioides caballeroi
C. mehrai	Present study,		Dissoura e. episcopa	
C. mehrai	Saksena,	1959	Dissoura e. episcopa	Described as Mehrastomum minutum
C. mehrai	Gupta,	1968	Xenorhynchus asiaticus	Described as Digitorchis yamaguti
C. seetali	Wesley,	1943	Xenorhynchus asiaticus	
C. seetali	Travassos,	1951	Ardea goliath & Xenorhynchus asiaticus	Described as C. dollfusi
C. seetali	Gupta,	1968	Dissoura episcopus	Described as Digitorchis stunkardi
C. bians	Fotedar*,	1969	Ardea cinerea	From Kulgam (Kashmir) New locality record



*Fotedar, personal communication.

TABLE II

A comparison of *Cathemasia indicus* with *Digitorchis odhneri*.

All measurements are in mms.

	Cathemasia indicus	*Digitorchis odhneri*
Body size	8.9-10.4 x 3-4	8.38-16.08 x 4.41-5.47
Oral sucker	0.85 x 0.95	0.75 - 0.88
Ventral sucker	1.4	1.27 - 1.30
Sucker ratio	1:1.5	1:2*
Head collar	Absent	Absent
& spines	Absent	Absent
Body scales	Present on ventral side	Present
Prepharynx	0.1 x 0.4	0.25 - 0.28
Pharynx	0.45	0.34-0.39 x 0.34-0.38
Esophagus	1.0	0.49 - 0.51
Ceca	With small outgrowths	With outgrowths
Vitellaria	Posterior level of Acetabulum	Middle of Acetabulum
Testes	Deeply branched	Deeply lobed
Cirrus sac	0.77 - 1.08	1.4 x 0.65
Seminal vesicle	Coiled	Saccular & slightly twisted
Egg size	0.056-0.08 x 0.026-0.04	0.045 x 0.06
Host	*Ibis leucocephalus*	*Ibis leucocephalus*
Location	Esophagus	Esophagus

* Ratio comes 1:1.5 from Fig. 1 page 333.

TABLE III

A comparison of *Cathemasia seetali* with *Digitorchis stunkardi*. All measurements are in mms.

	Cathemasia seetali	*Digitorchis stunkardi*
Body size	7-17.7 x 3-7.75	16.28-20 x 6.22-7.6
Oral sucker	1.3 x 1.5	1.54-1.98 x 1.04-1.54
Ventral sucker	2.3 x 2.45	2.0-2.05 x 2.08-2.1
Sucker ratio	1:1.5	1:1.5
Head collar	Absent	Absent
&spines	Absent	Absent
Body scales	Present on ventral side	Present on ventral side
Prepharynx	0.25 x 0.95	0.38-0.42
Pharynx	0.66 x 0.87	0.52-0.92
Esophagus	0.9	1.35-1.42
Ceca	Sinuated	Sinuated
Vitellaria	Behind the Acetabulum	Behind the Acetabulum
Testes	Very deeply branched into tubular outgrowths	Very deeply branched into tubular outgrowths
Cirrus sac	1 x 0.75	0.75-0.78 x 0.85-0.9
Seminal vesicle	Coiled	Saccular
Egg size	0.112 x 0.042	0.04-0.05 x 0.1-0.16
Host	*Xenorhynchus asiaticus*	*Dissoura episcopus*
Location	Esophagus	Esophagus

TABLE IV

A comparison of Cathemasia mehrai with Digitorchis yamaguti.

All measurements are in mms.

	Cathemasia mehrai	Digitorchis yamaguti
Body size	5.45-12.58 x 1.91-3.77	8.28-8.45 x 3.69-3.75
Oral sucker	0.464-0.754 x 0.58-0.986	0.675-0.682 x 0.78-0.785
Ventral sucker	0.638-1.392 x 0.661-1.45	1.14-1.45 x 1.75-1.758
Sucker ratio	1:1.5	1:2*
Head collar	Present	Absent
& spines	43-49 collar spines present	Absent
Body scales	Present both on dorsal & ventral side.	Present
Prepharynx	Short	0.18-0.158
Pharynx	0.35-0.81 x 0.29-0.69	0.345-0.348 x 0.42-0.423
Esophagus	0.406-1.16	0.756-0.785
Ceca	With outpocketings	with outgrowths
Vitellaria	Behind the acetabulum	Behind the acetabulum
Testes	Deeply lobed	Deeply lobed
Seminal vesicle	Bipartite & sac shaped	Saccular
Egg size	0.066-0.087 x 0.026-0.038	0.045 x 0.09
Host	Dissoura episcopa episcopa	Xenorhynchus asiaticus
Location	Esophagus	Esophagus

* Ratio comes 1:1.5 when calculated from Fig.3 page 337 in his paper.

REFERENCES

BROEK, E. VAN DEN, 1963 : Considerations on the taxonomy of the genus Cathemasia Looss, 1899 (Trematoda Cathemasiidae) Extrait des Archives Néerlandaises de Zoologie Tome XV, 4, 1963, p. 472-490.

FAROOQUI, H.U., 1960 : Cathemasioides caballeroi (Cathemasiidae-Trematoda) from an Indian Stork, Xenorhynchus asiaticus (latham). Sobretiro del Libro Homenaje al Dr. Eduardo Caballero y Caballero, p. 123-127.

GUPTA, A.N., 1968 : Studies on Digitorchis g.n. (Trematoda : Digenea) with the description of D. odhneri, D. stunkardi and D. yamaguti sp. n. Folia Parasitologica (Praha) 15 : 331-339.

PANDE, B.P., AHLUWALIA, S.S. AND SRIVASTAVA, J.S., 1959 : Note on host - parasite relationships observed in fluke infections of wild aquatic birds. Parasitology (1960), 50, 323-327.

SAKSENA, J.N., 1958 : On Mehrastomum minitum n.g., n.sp. (Trematoda : Digenea) from the intestine of White necked stork, Dissoura episcopa episcopa. Proceedings of the National Academy of Sciences, India Section B, Vol. XXIX, Part V, 1959, 240-244.

STUNKARD, H.W.,AND GANDAL, C.P., 1965 : A new Trematode, Cathemasia senegalensis, from the Saddle-bill stork, Ephippiorhynchus senegalensis (Shaw). Zoologica,

Scientific Contributions of the New York Zoological Society Vol. 50, Issue 2, Summer, 1965.

WESLEY, W.K., 1940 : Studies on the Indian species of the genus Cathemasia Looss with discussion on the family Cathemasiidae Fuhrmann, 1929. Proceedings of the National Academy of Sciences, India, Vol. 10, Part 2, 31-40.

WESLEY, W.K., 1943 : A new species of the genus Cathemasia Looss. Proceedings of the National Academy of Sciences, India, Vol. 13, Part 5, 328-332.